

## Claims

- [c1] A diffusion-based method for detecting the activity of a bio/chemical species, the method comprising:
- supplying a bio/chemical species to a finite volume diffusion channel, the finite volume diffusion channel comprising a transport axis;
  - supplying a reactive constituent in fluid communication to the finite volume diffusion channel, wherein the reactive constituent is known, or suspected of being reactive to the bio/chemical species;
  - detecting the presence or absence of a diffusion gradient occurring between the bio/chemical species and the reactive constituent; and
  - correlating the presence or absence of the diffusion gradient to the presence or absence of activity of the bio/chemical species.
- [c2] The method of claim 1, wherein supplying a bio/chemical species to the finite volume diffusion channel comprises supplying a first concentration of the bio/chemical species to the finite volume diffusion channel, and wherein supplying a reactive constituent comprises supplying a second concentration of the bio/chemical species to the finite volume diffusion channel.
- [c3] The method of claim 1, wherein supplying a bio/chemical species to the diffusion channel comprises supplying a population of cells to the finite volume diffusion channel, and wherein supplying a reactive constituent comprises supplying an ionic species to the finite volume diffusion channel.
- [c4] The method of claim 1, wherein supplying a bio/chemical species to the diffusion channel comprises supplying a population of cells to the finite volume diffusion channel, and wherein supplying a reactive constituent comprises supplying small molecules intended for therapeutic purposes to the finite volume diffusion channel.
- [c5] The method of claim 1, wherein supplying a bio/chemical species to the finite volume diffusion channel comprises depositing the bio/chemical species within the finite volume diffusion channel.
- [c6] The method of claim 1, wherein supplying a reactive constituent to the finite



diffusion channel comprises supplying a population of cells to the finite volume diffusion channel, and wherein supplying a reactive constituent comprises supplying small molecules intended for therapeutic purposes to the finite volume diffusion channel.

- [c13] The method of claim 8, wherein measuring the diffusion rate of the bio/chemical species comprises:
- positioning first and second measurement probes at respective first and second locations along the finite volume diffusion channel; and
  - measuring an optical or electrical parameter at the first and second measurement probes; and
  - detecting a difference in the measured optical or electrical parameter.
- [c14] A diffusion-based detector configured to detect or monitor the activity of a bio/chemical species, the detector comprising:
- a finite volume diffusion channel operable to contain a fluid volume therein, the finite volume diffusion channel comprising a transport axis along which the fluid volume travels, wherein the fluid volume, when present, includes a source constituent comprising either (i) the bio/chemical species or (ii) a reactive constituent known or suspected of being reactive with the bio/chemical species;
  - a first measurement probe located at a first position along the transport axis and operable to measure the concentration of the source constituent within the fluid volume at the first position; and
  - a second measurement probe located at a second position along the transport axis and operable to measure the concentration of the source constituent within the fluid volume at the second position,
- wherein, activity of the bio/chemical species is indicated if the concentration of the source constituent measured at the first measurement probe differs from the concentration of the source constituent measured at the second measurement probe.
- [c15] The diffusion-based detector of claim 14, wherein the first and second measurement probes are operable to support the propagation of electrical signals.

- [c16] The diffusion-based detector claim 14, wherein the first and second measurement probes are operable to support the propagation of RF frequency signals.
- [c17] The diffusion-based detector claim 14, wherein the first and second measurement probes are operable to support the propagation of optical signals.
- [c18] The diffusion-based detector of claim 14, wherein the finite volume diffusion channel comprises a microfluidic channel.
- [c19] The diffusion-based detector of claim 15, wherein the first and second measurement probes are configured to measure the conductance of the fluid volume at the first and second positions, respectively.
- [c20] A diffusion-based detector configured to detect or monitor the activity of a bio/chemical species, the detector comprising:  
a first finite volume diffusion channel operable to contain a fluid volume therein, the finite volume diffusion channel comprising:  
a transport axis along which the fluid volume travels, wherein the fluid volume, when present, includes a source constituent comprising either (i) the bio/chemical species or (ii) a reactive constituent known or suspected of being reactive with the bio/chemical species; and  
an interaction region disposed within the first finite volume diffusion channel and comprising a sink constituent which is known or suspected of being reactive to the source constituent;  
a first measurement probe located at a first position along the transport axis, the first measurement probe operable to measure the concentration of the source constituent within the fluid volume before flow to the interaction region;  
and  
a second measurement probe located at a second position along the transport axis, the second measurement probe operable to measure the concentration of the source constituent within the fluid volume after flow to the interaction region.
- [c21] The diffusion-based detector of claim 20, wherein the first and second

measurement probes are operable to support the propagation of electrical signals.

- [c22] The diffusion-based detector claim 20, wherein the first and second measurement probes are operable to support the propagation of RF frequency signals.
- [c23] The diffusion-based detector claim 20, wherein the first and second measurement probes are operable to support the propagation of optical signals.
- [c24] The diffusion-based detector of claim 20, wherein the finite volume diffusion channel comprises a microfluidic channel.
- [c25] The diffusion-based detector of claim 20, wherein the first and second measurement probes are configured to measure an electrical or optical parameter of the fluid volume at the first and second positions, respectively.
- [c26] The diffusion-based detector of claim 20, further comprising a second finite volume diffusion channel intersecting the first finite volume diffusion channel.
- [c27] A multi-cell detector configured to monitor the activity of a bio/chemical species, the multi-cell detector comprising:  
a finite volume diffusion channel operable to contain a fluid volume therein, the finite volume diffusion channel comprising a transport axis along which the fluid volume travels, wherein the fluid volume, when present, includes a source constituent comprising either (i) the bio/chemical species or (ii) a reactive constituent known or suspected of being reactive with the bio/chemical species;  
a first detector cell formed along a first portion of the finite volume diffusion channel, the first detector cell comprising:  
a first interaction region disposed within the first portion of the finite volume diffusion channel and comprising a first sink constituent which is known or suspected of being reactive to the source constituent;  
a first measurement probe located at a first position and operable to measure the concentration of the source constituent within the fluid volume before flow to the first interaction region; and  
a second measurement probe located at a second position and operable to

measure the concentration of the source constituent within the fluid volume after flow to the first interaction region; and

a second detector cell formed along a second portion of the finite volume diffusion channel, the second detector cell comprising:

a second interaction region disposed within the second portion of the finite volume diffusion channel and comprising a second sink constituent which is known or suspected of being reactive to the source constituent;

a first measurement probe located at a first position and operable to measure the concentration of the source constituent within the fluid volume before flow to the second interaction region; and

a second measurement probe located at a second position and operable to measure the concentration of the source constituent within the fluid volume after flow to the second interaction region.